

A REVIEW OF THE FLOUNDERS BELONGING TO THE GENUS *PLEURONICHTHYS*.

By EDWIN CHAPIN STARKS and WILLIAM FRANCIS THOMPSON,
Of Stanford University, California.

In the following paper six American species, and one Asiatic species, of the genus *Pleuronichthys* are described, including two new ones. Types and cotypes of the new species are deposited in the U. S. National Museum.

The distribution of each species is known only so far as specimens at hand indicate, for former records show *Pleuronichthys canosus* (representing four species) to occur along the entire west coast of the United States.

The species of the *canosus* group are very well separated geographically, though toward the limits of the area inhabited by each species there is more or less overlapping with areas of neighboring species. Specimens are in the National Museum or in the Stanford University collections, showing the following distribution:

Pleuronichthys nephelus, new species, is known only from Puget Sound.

Pleuronichthys canosus is found from San Francisco to San Pedro, California. Along the great length of coast between San Francisco and Puget Sound a species of this group occurs, but no records indicate whether it is *Pleuronichthys canosus* or *Pleuronichthys nephelus*, or whether, as is probable, both are found at some point.

Pleuronichthys ritteri is known from San Pedro southward along nearly the entire west coast of Lower California, or south to latitude 24°. (*Albatross station* 3042.)

Pleuronichthys ocellatus, new species, is known from rather deep water only from near the northern end of the Gulf of California.

Pleuronichthys decurrens is known from San Francisco southward to the Santa Barbara Islands.

Pleuronichthys verticalis is known from San Francisco to the Gulf of California, or along the entire known range of three of the species that have been confused with *Pleuronichthys canosus*.

Pleuronichthys cornutus is known along the coast of Japan north to Hakodate.

The drawings of the new species accompanying this paper are the work of Mr. W. S. Atkinson.

KEY TO THE SPECIES OF PLEURONICHTHYS.

- a*¹. Origin of dorsal well below level of snout; at least 9 rays on blind side of body.....*decurrens*.
- a*². Origin of dorsal at level of snout, or above; 5 or 6 rays on blind side of body.
- b*¹. Body and fins uniformly covered with brown spots nearly as large as the pupil; no teeth on eyed side of jaws; scales 95 to 108 (Asiatic species)....*cornutus*.
- b*². Body and fins not uniformly covered with brown spots (American species).
- c*¹. Interorbital ridge high and knife-like, ending behind in a sharp spine at least 1 diameter of the pupil above the surrounding level of the head; anterior bony tubercle overhanging mouth; no teeth on eyed side of jaws..*verticalis*.
- c*². Interorbital ridge not so high or sharp as described above; anterior bony tubercle not anterior to mouth; minute teeth on eyed side of mandible.
- d*¹. Scales less than 75 in a series below lateral line; color very dark; broad irregular blotches of dark color with sharp, darker, edges over body and fins; caudal peduncle short and deep with the tips of dorsal and anal rays almost, or quite, reaching bases of caudal rays; posterior interorbital spine very little, or not at all developed.....*nephelus*.
- d*². Scales more than 75; color lighter; caudal peduncle longer; posterior interorbital spine developed.
- e*¹. No bony tubercle developed on anterior end of interorbital ridge..*carnosus*.
- e*². Two bony tubercles developed on anterior end of interorbital ridge.
- f*¹. A spot at about middle of lateral line conspicuously ocellated with milk white; scales from 84 to 91; gill rakers below angle of arch 7 to 9.....*ocellatus*.
- f*². A spot on middle of lateral line often present, but not conspicuously ocellated with white; scales from 79 to 84; gill rakers 9 to 11...*ritteri*.

PLEURONICHTHYS DECURRENS Jordan and Gilbert.

This species may be at once known by the very low origin of the dorsal fin on the blind side of the body, the insertion being below the lower corner of the mouth, and at least nine rays are present on the blind side.

Head contained from $3\frac{1}{3}$ to $3\frac{2}{3}$ in length of body without caudal; depth of body $1\frac{1}{2}$ to 2. Upper orbit, $2\frac{1}{5}$ to 3 in length of head; maxillary 4 to $4\frac{1}{2}$; length of caudal peduncle 4 to $5\frac{1}{2}$; its depth $2\frac{1}{2}$ to 3. Number of dorsal rays 71 to 74; anal rays 46 to 49; scales in series below lateral line 90 to 95; gill rakers 3 or 4 + 7 to 9.

Head considerably thicker than body; the snout projecting beyond the dorsal contour, but less abruptly than in other species, leaving a broad concave area above it extending behind the eyes. The interorbital ridge bears a rather sharp spine at either end; the posterior one the larger; pointing backward and downward. In front of the anterior one, before the lower eye, is a small blunt tubercle, and behind the upper eye are two blunt but very prominent ones. The eyes are large and protruding, and the upper one is posterior to the lower. The dentition is stronger than usual. There are three rows of teeth on the blind side of each jaw; one on the eyed side of the mandible; none on the eyed side of the premaxillary.

The dorsal arises below, or at a level with, the corner of the mouth on the blind side of the head, and about nine rays are off the median line of the body. The ventral of the eyed side is considerably posterior to that of the blind, and the distance between their insertions is contained ten times in the head, or three and one-half times in the upper orbit. The caudal peduncle is longer and more slender than in any other American species in the genus.

The scales are small, not imbricated, and somewhat concealed by the skin, especially on the head. The dorsal branch of the lateral line runs back to about ten rays from the last ray of the dorsal, but the anterior branch is entirely lacking in the specimens at hand.

The color in alcohol is brownish, sometimes mottled with darker, especially at the middle of the lateral line, and posteriorly at the bases of the vertical fins. The vertical fins are brown, sometimes mottled, and narrowly edged with white. The posterior half of the caudal is dark and edged with white across the tips of the rays.

Here described from several specimens from between San Francisco and San Pedro, California, from 8 to 10 inches in length.

Measurements of *Pleuronichthys decurrens*.

Length of body without caudal, in mm.....	144	155	175	158
Depth of body in hundredths of length.....	50.7	53	50	54
Length of head.....	30	28	30	31
Upper orbit, longitudinal diameter.....	9.8	10	10	11
Distance across both orbits.....	13	14	13	15
Length of maxillary.....	7.3	6.2	6.5	6.2
Ventral of eyed side posterior to that of blind.....	3	3	2.7	3
Length caudal peduncle.....	6	7.5	6	5.5
Depth of caudal peduncle.....	10.5	11.5	10.5	11
Number of dorsal rays.....	72	71	71	74
Anal rays.....	48	46	49	49
Scales, below lateral line, in longitudinal series.....	92	95	90	90
Gill-rakers on first gill arches.....	13+7	4+9	4+8	4+8
	13+7	4+9	4+8	4+8

PLEURONICHTHYS CORNUTUS Schlegel.

This species is apparently most closely related to *Pleuronichthys verticalis*, having similar dentition; a somewhat similar interorbital ridge and spine (though not nearly so high); and a small number of gill-rakers. It differs from it in the greater number of scales; more numerous rays in the dorsal and anal fins; a smaller upper orbit, and a shorter and more slender caudal peduncle.

Head 4 to 4½ in length of body to base of caudal; depth 1⅔ to 2. Upper orbit 3 to 3½ in head; maxillary 4 to 4½; length of caudal peduncle 7 to 8; its depth 2. Number of dorsal rays 71 to 75; anal rays 52 to 57; scales in series below lateral line 100 to 108; gill-rakers 3+5 to 7.

The dorsal contour is broken slightly at the eye by the projecting snout as in *Pleuronichthys verticalis*. The interorbital ridge is moderate in height, trenchant and narrow, slightly overhanging the snout,

but not so much so as in *Pleuronichthys verticalis*. On it are two large prominent spines and a bony tubercle as follows: A large sharp spine pointing outward from the anterior end; a small tubercle in front of the lower orbit; and a large sharp spine pointing straight backward from the posterior end. On the posterior margin of the upper orbit are one or two very small tubercles, and a larger one is present on the anterior margin of the upper orbit. The maxillary extends to the anterior margin of the lower pupil, and is hidden anteriorly on the eyed side by the forward extension of the interorbital ridge. At the posterior end of the mandible there is a prominent angle. There are no teeth on the eyed side of either jaw, but bands of minute teeth on the blind side of both. The left nostrils are as near or nearer to the right nostrils than to the dorsal fin.

The dorsal fin begins at the level of the snout, or a little above, and has six rays on the blind side. The ventral of the blind side is anterior to that of the eyed side, and farther from the ventral median edge of the body. The caudal peduncle is somewhat shorter and not so deep as that of *Pleuronichthys verticalis*.

The scales are very small and not imbricated in adults anteriorly. The lateral line has a dorsal branch running back to about the fortieth dorsal ray, but the short anterior branch may be absent or present.

The color in alcohol is a light grayish brown, with small leopard-like dark brown spots scattered rather uniformly and thickly over the body and vertical fins. There are no indications of ocellated spots, or of regularly placed light spots such as are found on most of the American species. Among the specimens at hand are some colored partially or entirely on both sides. These have, in the latter case, more symmetrical pectoral and ventral fins: the upper eye more nearly on the dorsal outline of the body, and the dorsal beginning on a small free lobe overhanging the left margin of the upper orbit.

Here described from numerous specimens from Tsuruga and Aomori, Japan.

Measurements of Pleuronichthys cornutus.

Length of body without caudal, in mm.....	175	95	105	190	145
Depth of body in hundredths of length.....	55	56	50	60	55
Length of head.....	24	25	23	25	24
Longitudinal diameter of upper orbit.....	8	8	8	8	7
Distance across both orbits.....	12	11	13	11	10
Length of maxillary.....	5	6	5.5	6	6
Ventral of eyed side posterior to that of blind.....	2	2	2	2	1.5
Length of caudal peduncle.....	3.5	3	3.5	4	3.5
Depth of caudal peduncle.....	42	12.5	11	13	12
Number of dorsal rays.....	75	75	74	71	75
Anal rays.....	57	56	55	52	54
Scales, below lateral line, in longitudinal series.....	108	105	100	100	100
Gill-rakers on first gill arches.....	3+6	3+6	3+7	3+5	3+6
	3+6	3+6	3+6	3+6	3+6

PLEURONICHTHYS VERTICALIS Jordan and Gilbert.

This species may be known from all others of its genus by its prominent interorbital spines, its greater anterior projection of the interorbital ridge and bony tubercles over the tip of the snout, by its fewer gill-rakers, and from all American species by its having no teeth on the eyed side of either jaw.

Head $3\frac{2}{3}$ to 4 in length of body without caudal; depth, $1\frac{3}{5}$ to $2\frac{1}{5}$. Upper orbit, $2\frac{1}{2}$ to 3 in head; maxillary, 4 to 5; length of caudal peduncle, 5 to 6; its depth, $1\frac{4}{5}$ to 2. Number of dorsal rays, 68 to 71; anal rays, 45 to 48; scales, 88 to 96 in series below lateral line; gill-rakers, 2 or 3 + 6 or 7.

Dorsal outline broken at upper orbit by the projecting snout. The interorbital ridge high and anteriorly is continued so that it overhangs the snout, its anterior edge being almost vertical. On it are two prominent spines; the anterior one between the anterior thirds of the orbit, pointing upward and outward; the posterior on the end of the ridge, larger and sharper than in any other species, and pointing almost straight back. It is above the surface of the head a height equal to 1 diameter of the pupil. On the anterior end of the ridge, in front of the lower eye, is a bony tubercle, and on the posterior margin of the upper eye are three conspicuous blunt ones. A trenchant short ridge forms the anterior edge of the upper orbit and bears a short tubercle just in front of the eye. There are small teeth in bands on the blind side of both jaws, but none on the eyed side of either. The upper eye is considerably posterior to the lower, and the orbits are somewhat larger than in other species. The maxillary is concealed by the overhanging bony tubercle for the greater part of its length.

The dorsal fin arises on a level with the snout, and has five or six rays on the blind side. The insertion of the ventral on the eyed side is posterior to that on the blind a fourth or a fifth of the diameter of the upper orbit. The caudal peduncle is rather long; measuring from the base of the last anal ray to that of the lower caudal ray its length is contained five or six times in the head.

The scales are small, and are scarcely imbricated, especially toward the sides of the body. The dorsal branch of the lateral line extends back to under the middle of the dorsal, but the anterior branch is usually lacking in the adult.

The color in alcohol is uniform light brown with blotches of darker faintly shown near the middle of the lateral line, and at the base of the caudal peduncle. The vertical fins are mottled with large brown spots.

Here described from five specimens from San Francisco and from southern California, from 6 to 9 inches in length.

Measurements of Pleuronichthys verticalis.

Length of body without caudal, in mm.....	119	115	62	220	220
Depth of body in hundredths of length.....	48.5	52	48	57	54
Length of head.....	26	27	25	25	25
Longitudinal diameter of upper orbit.....	9.5	9.5	10	9	9
Distance across both orbits.....	10	9	11	10	10
Length of maxillary.....	6.2	5.5	6	5.5	5.5
Ventral of eyed side posterior to that of blind.....	2	2	2.5	2	2
Length of caudal peduncle.....	4.2	4.5	5	5	5
Depth of caudal peduncle.....	13.5	13.5	13	14	14
Number of dorsal rays.....	71	70	68	69	70
Anal rays.....	45	48	48	48	48
Scales, below lateral line, in longitudinal series.....	95	88	88	96	96
Gill-rakers on first gill arches.....	2+6 3+7	3+7 2+7	3+6 3+6	3+6 3+6	3+6 3+6

PLEURONICHTHYS NEPHELUS Starks and Thompson, new species.

This species has a fewer number of scales than any other of the genus; its low interorbital ridge is free from spines; and the ventral of its eyed side is not so far posterior to its fellow of the opposite side. From *Pleuronichthys canosus* it may be known in addition by the smaller diameter of the upper orbit.

Head from $3\frac{3}{4}$ to $4\frac{1}{2}$ in length of body without caudal; depth $1\frac{1}{2}$ to 2. Upper orbit 3 to $3\frac{1}{2}$ in head; maxillary $3\frac{1}{3}$ to 4; length of caudal peduncle measured to marginal caudal rays 7 or 8; its depth $1\frac{1}{2}$ to 2. Number of dorsal rays 66 to 75; anal rays 47 to 56; scales in series below lateral line 66 to 75; gill-rakers 3 or 4 + 9 to 11 (in one specimen 12).

Body very symmetrical in dorsal and ventral contours, which are evenly curved from caudal to tip of snout. The interorbital ridge is low and without prominent spines; at the anterior end are sometimes very slight indications of tubercles, and the position of the posterior spine is marked by little more than a slight angle, except in the type (the largest specimen) there is a blunt tubercle. The eyes are small, not very prominent, and nearly opposite to each other. The nostrils of the left side are close to the dorsal, and those of the right are not so far removed from those of the left as usual. The maxillary is not covered by the preorbital bones. There is a row of teeth on the eyed side of the mandible, but none on the premaxillary of that side, and three or four rows on the blind side of each jaw.

The dorsal fin arises a little above the level of the tip of the snout. The dorsal and anal extend so close to the base of the caudal that the tips of their last rays nearly or quite reach to the bases of the marginal caudal rays. The ventrals are more nearly opposite to each other in insertion than in other species of the genus; the distance of that of the eyed side behind that of its fellow of the opposite side is contained three or four times in the length of the maxillary. The caudal fin is very conspicuously broad and round in outline.

The scales are large and unimbricated over the entire body, sometimes much buried in the skin, the lateral line ascending less than usually anteriorly, with a short anterior branch, and a long posterior one ending under the middle of the dorsal.

PLEURONICHTHYS CÆNOSUS Girard.

This species differs from *Pleuronichthys ritteri* in having no bony tubercle on the anterior end of the interorbital ridge; a greater number of dorsal and anal rays; a greater number of scales; a shorter distance across both orbits; a shorter caudal peduncle; a lower, more symmetrical, dorsal, and ventral outline of body; a less abruptly protruding snout; and (in the specimens at hand) in having the usual spot at the middle of the lateral line absent.

Head 3 to 4 in length of body without caudal; depth 2. Long diameter of upper orbit $2\frac{2}{3}$ to $3\frac{1}{4}$ in head; maxillary 4; length of caudal peduncle to base of lower caudal rays 8 to $8\frac{1}{3}$; its depth 2. Number of dorsal rays 70 to 74; anal rays 50 to 53; scales in series below lateral line 80 to 91; gill-rakers 4 + 10 or 11.

Body oval in outline, the curve symmetrical with the snout scarcely projecting as it does in *Pleuronichthys ritteri*. There is a prominent angle at the posterior end of the mandible. The interorbital ridge is rather high and without spines save for a rather blunt one at the posterior end pointing backward and somewhat downward. Behind the upper eye is a small blunt tubercle not very prominent. The nostrils of opposite sides are three times as far apart as from the dorsal fin. There are three or four rows of teeth on the blind side of each jaw, and one row on the eyed side of the mandible, but no teeth on the eyed side of the premaxillary. The dorsal is inserted just at, or a little above, the level of the point of the snout, and about six rays are on the blind side. The right ventral is posterior to the left a fourth or a fifth of the long diameter of the upper orbit, and nearer to the ventral ridge than its fellow. The caudal peduncle is short and deep; measured to the marginal caudal rays its length is contained eight times in the head.

The scales are small, nowhere closely imbricated, but much less so in large individuals than in small ones, especially along the outer margins of the body. The lateral line has a short branch running anteriorly, and a longer one running posteriorly along the base of the dorsal fin to opposite its middle.

Color in alcohol dark brown with mottled, blended spots, slightly darker in color, especially at the middle of the lateral line, at the base of the caudal, and at the bases of the vertical fins posteriorly. A slightly dusky blotch is present on the caudal fin. The blended dusky blotch at the middle of the lateral line is not conspicuous as in *Pleuronichthys ritteri*.

Here described from specimens from San Francisco and San Pedro, California, from 8 to $13\frac{1}{2}$ inches in length

Measurements of *Pleuronichthys carnosus*.

Length of body without caudal, in mm.....	166	250	265
Depth of body in hundredths of length.....	53	52	53
Length of head.....	25	28	26
Upper orbit (longitudinal diameter).....	9.5	8.5	8.5
Distance across both orbits.....	9	11	11
Length of maxillary.....	6.5	6.5	7
Ventral of eyed side posterior to that of blind.....	2	2.5	2.3
Length of caudal peduncle.....	3	3.5	4.5
Depth of caudal peduncle.....	13	13	11
Number of dorsal rays.....	71	70	78
Number of anal rays.....	53	50	53
Scales in longitudinal series below lateral line.....	91	91	80
Gill-rakers on first gill-arches.....	$\left\{ \begin{array}{l} 4+10 \\ 4+11 \end{array} \right.$	$\left\{ \begin{array}{l} 4+10 \\ 4+11 \end{array} \right.$	$\left\{ \begin{array}{l} 3+9 \\ 4+8 \end{array} \right.$

PLEURONICHTHYS OCELLATUS Starks and Thompson, new species.

The nearest relative of this species is *Pleuronichthys ritteri*, from which it may be known by the presence of a very conspicuous spot

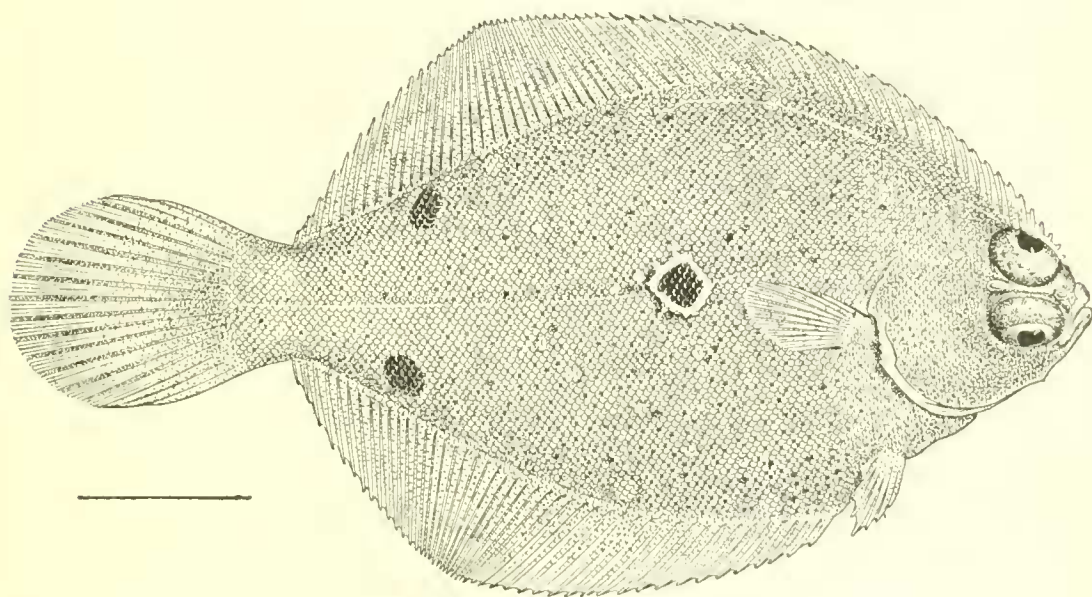


FIG. 2.—PLEURONICHTHYS OCELLATUS.

ocellated with milk white midway on the lateral line between the base of the caudal and the snout; by its fewer number of gill-rakers; its greater number of scales; the greater long diameter of its upper orbit, and its interorbital spine a little higher, sharper, and less inclined to bend downward.

Head from $3\frac{2}{3}$ to $4\frac{1}{5}$ in length of body without caudal; depth 2 to $2\frac{1}{5}$. Long diameter of upper orbit 2 to $2\frac{7}{10}$ in head; distance across both orbits two in head; length of maxillary $3\frac{1}{2}$ to 4; length of caudal peduncle, measured to marginal caudal rays, from 6 to $7\frac{1}{2}$; its depth two. Number of dorsal rays from 61 to 72; anal rays 41 to 50; scales in series below lateral line from 84 to 91; gill-rakers 3 or $4+7$ to 9.

The dorsal contour of body outlines broken conspicuously at the upper orbit by the projecting snout. The interorbital ridge is trenchant, narrow, and rather low. The spine on its posterior part

is rather low, and points straight backward. On its anterior end, close together, are two tubercles above the front of the lower eye; on the posterior margin of the upper orbit are two blunter, less conspicuous ones; a very small one is on the anterior margin of the upper eye. The eyes are large and protruding, and the upper one is posterior to the lower. The left nostrils are remote from the base of the dorsal fin, but nearer to it than to the right nostrils. The maxillary reaches nearly to the anterior margin of the pupil. There is one row of very minute teeth on the eyed side of the lower jaw, and closely set, small bands on the blind side of both jaws, but none on the premaxillary of the eyed side.

The dorsal fin springs from, or slightly above, the level of the tip of the snout, with five or six rays on the blind side. The anal and dorsal are equal in height, the longest ray is contained seven times in the length of the body. The ventral of the eyed side is much posterior to that of the blind, and at a considerable distance from the ventral body ridge.

The scales are small and imbricated over the whole body, or at least in contact with each other. The lateral line has a dorsal branch running back from the head to about the thirty-fifth dorsal ray, and a short anterior branch is usually present.

The color in alcohol is uniform light brown on the eyed side, with a very prominent dark brown spot ocellated with milk white at the middle of the lateral line. A very inconspicuous, similar spot is at the base of the dorsal and anal fins posteriorly. Spots of white of irregular size, but very indefinite, are scattered over the body, especially along the bases of the vertical fins.

Here described from nine specimens from *Albatross* stations 3027 and 3024, in the Gulf of California. The type is from the latter station, and is 6 inches in length. It is deposited in the U. S. National Museum. Cotypes from the same locality in the National Museum have been examined (16 specimens examined altogether). Other cotypes are deposited in the collections of Stanford University.

Measurements of Pleuronichthys ocellatus.

Length in mm. of body without caudal.....	100	124	103	115	110	96	103
Depth of body in hundredths of body length.....	49.5	52	51	52	52	50	49.5
Length of head.....	25	26.5	24.5	27	25.5	24	24
Longitudinal diameter of upper orbit.....	10	9	10	11	10	11	10
Distance across both orbits.....	12	13	11.5	12.5	12	11	11.5
Length of maxillary.....	6	7	7	7	7	7	5.5
Ventral of eyed side posterior to that of blind.....	2.5	2.5	2.5	3	2	2	2.5
Length of caudal peduncle.....	4.5	4	3.5	5.5	3	3	4
Depth of caudal peduncle.....	12	14	13.5	13	13.5	13.5	12
Number of dorsal rays.....	67	66	69	61	71	66	71
Anal rays.....	46	47	48	44	50	46	50
Scales in longitudinal series below lateral line.....	90	89	89	84	90	85	91
Gill-rakers on first gill-arches.....	3+7 4+8	3+7 4+7	4+8 4+8	4+8 4+8	3+7 4+8	4+8 3+8	3+9 4+9

